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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
YIGDALL, MICHAEL J	

ART UNIT	PAPER NUMBER
2192	

DATE MAILED: 05/02/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/039,789	POULSEN ET AL.	
	Examiner	Art Unit	
	Michael J. Yigdall	2192	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 February 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3,6-8,10-15,18 and 20-26* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3,6-8,10-15,18 and 20-26* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. This Office action is responsive to Applicant's submission filed on February 10, 2006. Claims 1, 3, 6-8, 10-15, 18 and 20-26 are pending.

Response to Arguments

2. Applicant's arguments have been fully considered but they are not persuasive.

Applicant contends that neither Poulsen nor Sundaresan teaches or suggests translating a program unit into two different program units to perform different functions (remarks, page 2, third paragraph).

However, as presented in the Office action mailed on November 21, 2005, Poulsen does indeed teach translating a program 100 (i.e., "a first program unit") into a translated parallel computer program 130 (see, for example, column 8, lines 32-35) that includes two different program units. The two different program units perform different functions. Specifically, Poulsen discloses translating global storage objects from program 100 (see, for example, column 8, lines 29-30) into privatizable storage object declarations (i.e., "a third program unit") that encapsulate the global storage objects (see, for example, column 8, lines 59-61), and translating parallel regions from program 100 (see, for example, column 8, lines 29-30) into library calls (i.e., "a second program unit") that initialize the parallel regions and reference the privatizable storage object declarations (see, for example, column 9, lines 2-21). Thus, Poulsen discloses translating a first program unit into two different program units to perform different functions. The function of the third program unit is to encapsulate the global storage objects of the first

program unit, and the function of the second program unit is to initialize the parallel regions of the first program unit with reference to the third program unit.

Furthermore, Poulsen discloses that the operations of the global storage objects are partitioned among a plurality of threads (see, for example, column 6, lines 46-54). It is noted that Poulsen does not disclose a reduction operation that performs an algebraic operation on a set of variables. Nonetheless, Sundaresan discloses a reduction operation partitioned among a plurality of threads that performs an algebraic operation on a set of values (see, for example, column 7, lines 13-16 and column 1, lines 59-63). The reduction operation is encapsulated in a reusable reduction object (see, for example, column 5, lines 7-14).

Applicant contends that there is no teaching or suggestion in the references to combine them (remarks, page 2, last paragraph).

First, it is noted that combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art can establish obviousness. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988), and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992).

Second, it is noted that Applicant construes the combination of Poulsen and Sundaresan in ways that were not proposed in the Office action, stating that there is no teaching or suggestion to (a) transform the thread privatizable objects of Poulsen into reduction operations, or (b) modify the parallel program of Sundaresan to use such thread privatizable storage objects (remarks, page 3, first paragraph).

Instead, however, as set forth in the Office action, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include a reduction operation in Poulsen, such as with the reusable reduction object taught in Sundaresan. Improving the expressibility and maintainability of a parallel computer program (remarks, page 2, last paragraph) is an advantage of the reusable reduction object, and is thus a motivation to use the reusable reduction object in Poulsen. Furthermore, the privatization taught in Poulsen enhances the parallelism and performance of the parallel computer program (see, for example, column 1, lines 34-49), and therefore does suggest applying the translation to a parallel computer program that includes a reduction operation. As Sundaresan discloses, the reduction operation incorporates global storage objects suitable for such privatization (see, for example, FIG. 3 and column 10, line 60 to column 11, line 4).

Notwithstanding Applicant's allegation to the contrary (remarks, page 3, first paragraph), there is no indication that the proposed modification would change the principle of operation of Poulsen.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1, 3, 6-8, 10-15, 18, 20, 21, 23, and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,812,852 to Poulsen et al. (art of record, "Poulsen") in view of U.S. Patent No. 5,937,194 to Sundaresan (art of record, "Sundaresan").

With respect to claim 1 (previously presented), Poulsen discloses a method comprising:

(a) receiving a first program unit in a parallel computing environment (see, for example, column 8, lines 29-30, which shows receiving a first parallel computer program unit).

Although Poulsen discloses that the first program unit includes parallel regions and global storage objects (see, for example, column 8, lines 29-30), Poulsen does not expressly disclose the limitation wherein the first program unit includes a reduction operation associated with a set of variables.

However, Sundaresan discloses a reduction operation associated with a set of values or variables, wherein the reduction operation performs an algebraic operation on the values or variables and is partitioned among a plurality of threads (see, for example, column 7, lines 13-16, and column 1, lines 59-63). The reduction operation in Sundaresan is encapsulated in reusable reduction objects so as to improve the expressibility and maintainability of parallel code (see, for example, column 5, lines 7-14, 21-23 and 30-33).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the system of Poulsen to include a reduction operation, such as with the reusable reduction objects taught by Sundaresan, for the purpose of improving the expressibility and maintainability of the parallel computer program. Furthermore, one of ordinary skill in the art would have been motivated to enhance the parallelism and performance of a parallel computer program (see, for example, Poulsen, column 1, lines 34-49) that includes such a

reduction operation, given that the reduction operation is a candidate for this enhancement (see, for example, Sundaresan, column 10, line 60 to column 11, lines 4).

Therefore, Poulsen in view of Sundaresan discloses receiving a first program unit in a parallel computing environment, the first program unit including a reduction operation associated with a set of variables.

Poulsen in view of Sundaresan further discloses:

(b) translating the first program unit into a second program unit, the second program unit including a set of one or more instructions to partition the reduction operation between a plurality of threads including at least two threads and to reference a third program unit (see, for example, Poulsen, column 8, lines 32-35, which shows translating the program, and column 9, lines 2-12, which further shows translating parallel regions into library calls or a second program unit that references privatizable storage object declarations or a third program unit, and see, for example, Sundaresan, column 7, lines 13-16, which shows that the reduction operation is partitioned among a plurality of threads, as presented above); and

(c) translating the first program unit into the third program unit, the third program unit including a set of one or more instructions that encapsulate the reduction operation to perform an algebraic operation on the variables (see, for example, Poulsen, column 8, lines 32-35, which shows translating the program, and column 8, lines 59-61, which further shows translating global storage objects into privatizable storage object declarations or a third program unit that encapsulates the global storage objects, and see, for example, Sundaresan, column 7, lines 13-16, and column 1, lines 59-63, which shows that the reduction operation performs an algebraic

operation on the values or variables, as presented above, and column 5, lines 7-14, which further shows that the reduction operation is encapsulated in a reduction object).

With respect to claim 3 (previously presented), Poulsen in view of Sundaresan further discloses reducing the set of variables logarithmically (see, for example, Sundaresan, column 7, lines 16-18, which shows that the reduction operation reduces the values or variables logarithmically).

With respect to claim 6 (original), Poulsen in view Sundaresan further discloses associating the plurality of threads each with a unique portion of the set of variables (see, for example, Sundaresan, column 7, lines 20-21, which shows that the reduction operation associates individual values or variables to each of the threads).

With respect to claim 7 (original), Poulsen in view of Sundaresan further discloses combining, in part, the variables associated with the plurality of threads in a pair-wise reduction operation (see, for example, Sundaresan, column 11, line 48 to column 12, line 7, which shows a sample reduction operation that combines the values or variables associated with the plurality of threads in a pair-wise reduction operation, wherein a given thread has a fan-in of two threads, which is to say a pair of threads).

With respect to claim 8 (previously presented), Poulsen discloses an apparatus comprising:

(a) a memory including a shared memory location (see, for example, column 8, lines 37-39, which shows a memory, and column 7, lines 7-10, which shows a global storage object in a shared memory location);

(b) a translation unit coupled with the memory (see, for example, column 8, lines 32-35, which shows a translation means).

Although Poulsen discloses a first parallel computer program unit (see, for example, column 8, lines 29-30) and further discloses translating the first program unit (see, for example, column 8, lines 32-35), Poulsen does not expressly disclose the limitation wherein the translation unit is to translate a first program unit including a reduction operation associated with a set of at least two variables into a second program unit, the second program unit to partition the reduction operation between a plurality of threads including at least two threads and to reference a third program unit, and wherein the translation unit is to also translate the first program unit into the third program unit, the third program unit to encapsulate the reduction operation to perform an algebraic operation on the variables.

However, Sundaresan discloses a reduction operation associated with a set of values or variables, wherein the reduction operation performs an algebraic operation on the values or variables and is partitioned among a plurality of threads (see, for example, column 7, lines 13-16, and column 1, lines 59-63). The reduction operation in Sundaresan is encapsulated in reusable reduction objects so as to improve the expressibility and maintainability of parallel code (see, for example, column 5, lines 7-14, 21-23 and 30-33).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the system of Poulsen to include a reduction operation, such as with the

reusable reduction objects taught by Sundaresan, for the purpose of improving the expressibility and maintainability of the parallel computer program. Furthermore, one of ordinary skill in the art would have been motivated to enhance the parallelism and performance of a parallel computer program (see, for example, Poulsen, column 1, lines 34-49) that includes such a reduction operation, given that the reduction operation is a candidate for this enhancement (see, for example, Sundaresan, column 10, line 60 to column 11, lines 4).

Therefore, Poulsen in view of Sundaresan discloses a translation unit coupled with the memory, the translation unit to translate a first program unit including a reduction operation associated with a set of at least two variables into a second program unit, the second program unit to associate the reduction operation with one or more instructions operative to partition the reduction operation between a plurality of threads including at least two threads, the translation unit to also translate the first program unit into a third program unit, the third program unit to associate the reduction operation with a set of one or more instructions operative to perform an algebraic operation on the variables (see the rejection of claim 1 above).

Poulsen in view of Sundaresan further discloses:

(c) a compiler unit coupled with the translation unit and the memory, the compiler unit to compile the second program unit and the third program unit (see, for example, Poulsen, column 8, lines 42-45, which shows an executable program, which is to say a compiled program, and column 13, lines 11-13, which shows that the translation may be integrated with a compiler); and

(d) a linker unit coupled with the compiler unit and the memory, the linker unit to link the compiled second program unit and the compiled third program unit with a library (see, for

example, Poulsen, column 8, lines 39-42, which shows a linker for linking the program with a library).

With respect to claim 10 (previously presented), Poulsen in view of Sundaresan further discloses the limitation wherein the variables in the set of variables are each uniquely associated with the plurality of threads and the library includes instructions to combine, in part, the variables associated with the plurality of threads (see, for example, Poulsen, column 10, lines 9-11 and 15-19, which shows that instructions in the library are called for each parallel region in the program, and Sundaresan, column 7, lines 20-21, which shows that the reduction operation associates individual values or variables to each of the threads).

With respect to claim 11 (previously presented), Poulsen in view of Sundaresan further discloses the limitation wherein the library includes instructions to combine, in part, the variables in a pair-wise reduction (see, for example, Sundaresan, column 11, line 48 to column 12, line 7, which shows a sample reduction operation that combines the values or variables associated with the plurality of threads in a pair-wise reduction operation, wherein a given thread has a fan-in of two threads, which is to say a pair of threads).

With respect to claim 12 (original), Poulsen in view of Sundaresan further discloses a set of one or more processors to host the plurality of threads, the plurality of threads to execute instructions associated with the second program unit (see, for example, Poulsen, column 6, lines 46-50, which shows one or more processors for executing the plurality of threads).

With respect to claim 13 (previously presented), Poulsen in view of Sundaresan further discloses the limitation wherein the third program unit includes a callback routine and the callback routine is associated with instructions operative to perform the algebraic operation on at least two variables in the set of variables (see, for example, Poulsen, column 9, line 63 to column 10, line 9, which shows callback routines for the parallel regions in the program, and Sundaresan, column 7, lines 13-16, and column 1, lines 59-63, which shows that the reduction operation performs an algebraic operation on the values or variables).

With respect to claim 14 (original), Poulsen in view of Sundaresan further discloses the apparatus of claim 13 wherein the library is operative to call the callback routine to perform, in part, a reduction on at least two variables in the set of variables (see, for example, Poulsen, column 10, lines 9-11 and 15-19, which shows that the routines in the library are called for each parallel region in the program, and Sundaresan, column 7, lines 13-16, which shows that the reduction operation performs a reduction on the values or variables).

With respect to claim 15 (previously presented), the limitations recited in the claim are analogous to the limitations recited in claim 1 (see the rejection of claim 1 above). Poulsen in view of Sundaresan further discloses a machine-readable medium that provides instructions, that when executed by a set of one or more processors, enable the set of processors to perform the recited method (see, for example, Poulsen, column 8, lines 37-39, and column 6, lines 46-50).

With respect to claim 18 (previously presented), see the rejection of claim 3 above.

With respect to claim 20 (previously presented), see the rejection of claim 7 above.

With respect to claim 21 (previously presented), Poulsen in view of Sundaresan further discloses performing a plurality of reduction operations in the third program unit (see, for example, Sundaresan, column 12, line 64 to column 13, line 2, which shows performing a plurality of reduction operations).

With respect to claim 23 (previously presented), Poulsen in view of Sundaresan further discloses a run-time library to implement the reduction operation (see, for example, Poulsen, column 9, line 63 to column 10, line 9, which shows a run-time library to implement the parallel operations).

With respect to claim 26 (previously presented), Poulsen in view of Sundaresan further discloses the limitation wherein the third program unit is to perform the algebraic operation using the library (see, for example, Poulsen, column 9, line 63 to column 10, line 9, which shows that the parallel operations are performed using the library).

5. Claims 22, 24 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Poulsen in view of Sundaresan, as applied to claims 1 and 8 above, respectively, and further in view of U.S. Patent No. 6,212,617 to Hardwick (now made of record, "Hardwick").

With respect to claim 22 (previously presented), Poulsen in view of Sundaresan does not expressly disclose performing a vector reduction operation in the third program unit via a N-dimension loop in the third program unit.

However, Hardwick discloses reduction operations that are applied to vectors formed from the basic data types (see, for example, column 6, lines 27-39). The vector reduction

operations are performed via loops in such a manner as to ensure portability across different parallel architectures (see, for example, column 6, lines 40-49).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the system of Poulsen and Sundaresan to perform reduction operations on vectors via loops in the third program unit, such as taught by Hardwick. One of ordinary skill in the art would have been motivated to extend the type-specific reduction operations of Sundaresan (see, for example, column 12, lines 10-15) to further include vectors formed from the basic data types.

With respect to claim 24 (previously presented), although Sundaresan discloses performing a plurality of reduction operations (see, for example, column 12, line 64 to column 13, line 2), Poulsen in view of Sundaresan does not expressly disclose the limitation wherein the third program unit is to perform a plurality of vector operations.

However, Hardwick discloses reduction operations that are applied to vectors formed from the basic data types (see, for example, column 6, lines 27-39). The vector reduction operations are performed in such a manner as to ensure portability across different parallel architectures (see, for example, column 6, lines 40-49).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the system of Poulsen and Sundaresan to perform reduction operations on vectors in the third program unit, such as taught by Hardwick. One of ordinary skill in the art would have been motivated to extend the type-specific reduction operations of Sundaresan (see, for example, column 12, lines 10-15) to further include vectors formed from the basic data types.

With respect to claim 25 (previously presented), Poulsen in view of Sundaresan does not expressly disclose the limitation wherein the third program unit is to perform a vector reduction operation via a N-dimension loop.

However, Hardwick discloses reduction operations that are applied to vectors formed from the basic data types (see, for example, column 6, lines 27-39). The vector reduction operations are performed via loops in such a manner as to ensure portability across different parallel architectures (see, for example, column 6, lines 40-49).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the system of Poulsen and Sundaresan to perform reduction operations on vectors via loops in the third program unit, such as taught by Hardwick. One of ordinary skill in the art would have been motivated to extend the type-specific reduction operations of Sundaresan (see, for example, column 12, lines 10-15) to further include vectors formed from the basic data types.

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael J. Yigdall whose telephone number is (571) 272-3707. The examiner can normally be reached on Monday through Friday from 7:30am to 4:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tuan Q. Dam can be reached on (571) 272-3695. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

MY

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